

DIFFUSE GALACTIC LIGHT OBSERVATIONS AT 206 SELECTED AREAS

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ABSTRACT

Space-based, observational diffuse galactic light (DGL) levels at 4400\AA are presented as a function of galactic latitude (b). A peak in the ratio of DGL to direct starlight is apparent at $|b| = 5^\circ$ to 15° , where one third of the celestial brightness is due to scattered light. Another salient feature is the general decrease in the relative contribution of the DGL at intermediate and high galactic latitudes. The relationship $\text{DGL} (S_{10(V)G2V,4400\text{\AA}}) = 2.4 \cdot 10^{-20} N_{\text{HI}} \text{ atoms cm}^{-2}$ may be used to estimate the brightness of DGL from neutral hydrogen column densities when $N_{\text{HI}} < 2 \cdot 10^{21} \text{ atoms cm}^{-2}$.

The results presented here have been used to characterize the interstellar dust in the general interstellar medium. A galaxy model that reproduces observed brightness levels was used to compare theoretical and observed DGL values. This determines two grain parameters - the albedo and the asymmetry of the scattering phase function (g). The results are albedo = $.61 \pm .07$, $g = .6 \pm .2$.

OBSERVATIONS

Photometry from the Pioneer 10 deep space probe permits direct observation of light from beyond the solar system. Accurate DGL information at blue wavelengths can be obtained from comparison of Pioneer photometry with the detailed star counts of Roach and Megill (1961), Sharov and Lipaeva (1973), or Tanabe (1973). The Roach and Megill tabulation is derived from a grid of l^I , b^I entries, obtained by interpolating data from the 206 Kapteyn Selected Areas (hereafter SAs). Subtracting discrete stars and integrated starlight from observations taken beyond the influence of zodiacal light provides the DGL brightness in Table 1. The first two columns give the SA designation followed by its galactic latitude. The third column contains the sum of DGL plus extragalactic background light (EBL), along with the standard deviation. The last column presents the ratio of DGL+EBL to total line of sight starlight (hereafter I_{LOS}). Corrections for the EBL are generally ignored due to the faintness of the EBL and the observational uncertainties associated with its detection.

Grouping the data into 25 latitude bins, the ratio of DGL+EBL to I_{LOS*} as a function of latitude is plotted in Figure 1. A peak at $5^\circ < |b| < 15^\circ$ and a drop in the relative contribution of DGL at high latitudes are the salient features. Variations from the often used assumption of a constant, latitude-independent ratio are evident.

The observed DGL levels at $|b| > 10^\circ$ and the neutral hydrogen column density (Heiles, 1975) were compared. The well known correlation between the gas and dust spatial distributions suggests that the DGL should vary according to the extinction along the line of sight. The relationship between DGL and N_{HI} at 4407\AA is

$$DGL(S_{10(V)G2V}) = 2.4 \cdot 10^{-20} N_{HI} \text{ atoms cm}^{-2},$$

where $1S_{10(V)G2V} = 1.16 \cdot 10^{-9} \text{ erg cm}^{-2} \text{ s}^{-1} \text{ ster}^{-1} \text{\AA}^{-1}$.

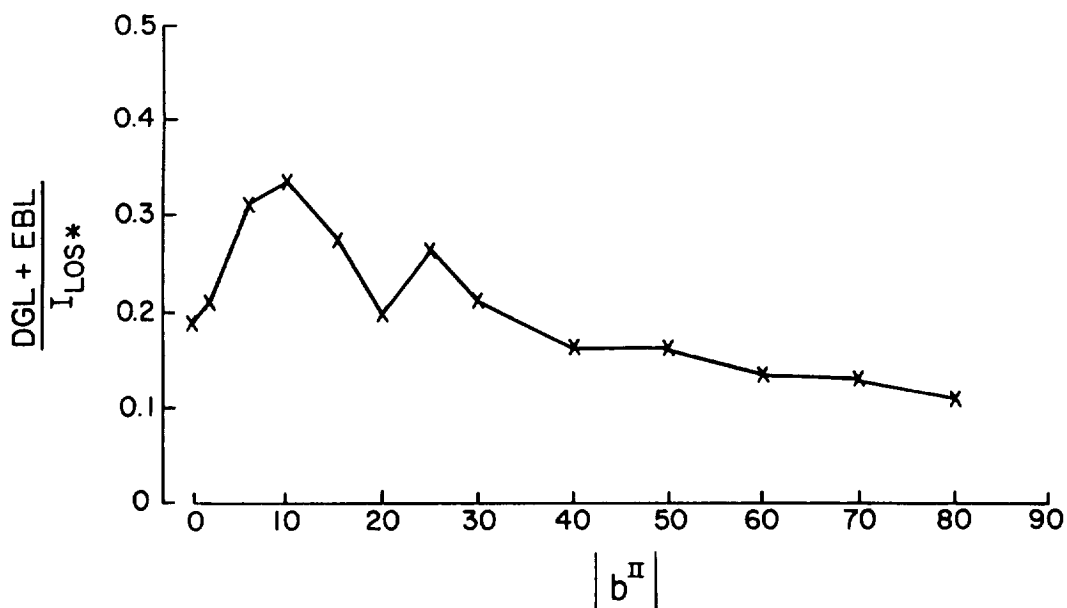


Figure 1. Latitude dependence of (DGL+EBL) divided by direct starlight.

Table 1. Diffuse Galactic Light Plus Cosmic Light
at the Selected Areas

SA	b ^{II}	DGL+EBL $\pm\sigma$	<u>DGL+EBL</u> I _{LOS} *	SA	b ^{II}	DGL+EBL $\pm\sigma$	<u>DGL+EBL</u> I _{LOS} *
1	28.0	20 \pm 7	.35	44	-31.9	2.5 \pm 7	.03
2	13.2	29 \pm 7	.27	45	-31.4	11 \pm 7	.15
3	17.6	27 \pm 9	.30	46	-27.2	27 \pm 8	.41
4	31.7	7 \pm 7	.11	47	-21.3	46 \pm 9	.84
5	42.6	6 \pm 7	.12	48	-12.4	19 \pm 11	.23
6	36.3	7.5 \pm 7	.13	49	- 2.4	5 \pm 44	.03
7	20.8	22 \pm 8	.28	50	8.9	42 \pm 15	.27
8	- 2.1	47 \pm 15	.27	51	20.9	26 \pm 9	.29
9	2.4	57 \pm 16	.43	55	73.1	12.5 \pm 7	.32
10	12.7	24 \pm 8	.26	56	79.2	6.5 \pm 7	.20
11	26.2	13 \pm 7	.17	57	85.5	3 \pm 7	.10
12	40.7	8 \pm 7	.16	58	73.8	4 \pm 7	.10
13	53.3	13 \pm 7	.29	59	60.3	6 \pm 7	.13
14	57.6	3.5 \pm 7	.08	60	48.7	3 \pm 7	.06
15	48.9	6.5 \pm 7	.13	61	35.4	1 \pm 8	.01
16	33.3	2 \pm 7	.03	62	23.8	7 \pm 16	.06
17	19.5	15 \pm 9	.14	63	10.8	37 \pm 22	.19
18	7.1	22 \pm 13	.13	64	- 0.2	0 \pm 58	0
19	- 0.7	17 \pm 20	.09	65	-10.7	48 \pm 18	.27
20	-17.0	12 \pm 11	.10	66	-19.5	24 \pm 11	.23
21	-16.5	19 \pm 11	.15	67	-26.9	24 \pm 13	.34
22	-12.9	43 \pm 12	.33	68	-46.1	5.5 \pm 7	.11
23	- 7.4	47 \pm 12	.38	69	-46.6	6.5 \pm 7	.13
24	- 0.2	66 \pm 26	.55	70	-42.1	13.5 \pm 8	.31
25	8.0	65 \pm 13	.54	71	-34.8	19 \pm 7	.36
26	17.4	30 \pm 9	.33	72	-24.7	40 \pm 9	.79
27	27.9	14 \pm 7	.21	73	-12.5	39 \pm 10	.38
28	38.7	9.5 \pm 7	.16	74	0.2	76 \pm 53	.32
30	58.9	12 \pm 7	.27	75	12.9	28 \pm 12	.20
31	68.1	8.5 \pm 7	.20	79	65.6	25.5 \pm 7	.61
32	72.8	0.5 \pm 7	.01	80	75.0	8 \pm 7	.21
33	68.4	8. \pm 7	.19	81	75.7	6 \pm 7	.18
34	60.3	6.5 \pm 7	.14	82	66.3	8.5 \pm 7	.20
35	50.1	4 \pm 7	.08	83	54.6	4.5 \pm 7	.10
36	40.0	1 \pm 7	.02	84	40.9	6.5 \pm 7	.11
37	28.9	7 \pm 8	.08	85	28.0	17 \pm 10	.21
38	19.3	16 \pm 13	.13	86	14.6	24 \pm 12	.17
39	9.4	0 \pm 35	0	87	1.7	69 \pm 43	.47
40	0.8	75 \pm 54	.35	88	-10.5	49 \pm 18	.26
41	- 7.0	31 \pm 18	.14	89	-21.9	21 \pm 9	.21
42	-12.4	41 \pm 23	.29	90	-33.1	18.5 \pm 7	.28
43	-16.4	38 \pm 20	.33	91	-41.7	13 \pm 7	.25

SA	b ^{II}	DGL+EBL±σ	<u>DGL+EBL</u> I _{LOS} *	SA	b ^{II}	DGL+EBL±σ	<u>DGL+EBL</u> I _{LOS} *
92	-62.1	4.5± 7	.10	141	-85.8	0 ± 7	0
93	-58.1	6 ± 7	.13	142	-73.1	2.5± 7	.06
94	-49.2	17.5± 7	.38	143	-60.8	4 ± 7	.09
95	-38.1	30.5± 13	.76	144	-47.5	1 ± 7	.02
96	-26.0	27 ± 8	.36	145	-35.2	0 ± 8	0
97	-12.1	64 ± 20	.67	146	-23.0	6 ± 14	.06
98	0.0	37 ± 27	.14	147	-10.3	49 ± 42	.25
99	13.8	27 ± 12	.18	148	0.1	43 ± 39	.14
102	50.4	24 ± 7	.54	149	11.5	33 ± 14	.24
103	59.2	9.5± 7	.21	150	19.9	25 ± 9	.28
104	62.3	0 ± 7	0	151	26.7	5 ± 7	.06
105	59.2	8.5± 7	.18	152	32.1	4.5± 7	.06
106	50.5	24 ± 7	.45	153	31.4	7.5± 12	.09
107	41.3	13.5± 7	.26	154	28.0	9 ± 8	.10
108	29.3	18 ± 7	.25	155	21.0	16 ± 10	.14
109	14.6	34 ± 12	.33	156	12.5	66 ± 18	.45
110	2.1	55 ± 51	.63	157	1.9	0 ± 50	0
111	-10.2	70 ± 25	.55	158	- 8.8	171 ± 35	.61
112	-24.1	10 ± 8	.10	159	-20.7	0 ± 18	0
113	-36.8	15 ± 7	.26	160	-33.5	10.5± 8	.13
114	-48.3	13.5± 7	.28	161	-46.8	8 ± 7	.14
115	-57.5	7.5± 7	.17	162	-58.8	4.5± 7	.09
116	-75.0	4.5± 7	.10	163	-71.4	3 ± 7	.07
117	-75.7	3 ± 7	.07	164	-72.9	2.5± 7	.06
118	-65.8	2.5± 7	.06	165	-70.1	0 ± 7	0
119	-54.4	3 ± 7	.06	166	-62.3	2 ± 7	.04
120	-40.9	4.5± 7	.08	167	-52.0	7 ± 8	.15
121	-26.9	35 ± 17	.53	168	-41.2	0 ± 7	0
122	-14.5	59 ± 26	.47	169	-30.7	0 ± 12	0
123	- 0.8	22 ± 23	.07	170	-20.6	3 ± 10	.02
124	11.3	28 ± 13	.19	171	-11.1	49 ± 52	.27
125	22.7	13 ± 8	.14	172	- 1.9	0 ± 54	0
126	33.9	21.5± 7	.36	173	5.3	37 ± 52	.19
127	41.4	6 ± 7	.11	174	11.4	69 ± 38	.58
128	46.4	10 ± 9	.20	175	15.5	23 ± 14	.20
129	46.8	13.5± 7	.24	176	17.3	22 ± 17	.13
130	42.8	10 ± 10	.19	177	16.2	0 ± 28	0
131	34.7	26 ± 8	.38	178	11.8	58 ± 44	.38
132	24.5	37 ± 9	.45	179	6.3	91 ± 53	.56
133	12.6	66 ± 13	.54	180	- 0.8	47 ± 55	.18
134	0.9	16 ± 35	.05	181	- 9.7	136 ± 51	.65
135	-12.6	21 ± 18	.10	182	-19.7	0 ± 39	0
136	-25.2	0 ± 9	0	183	-30.5	1.5± 8	.02
137	-38.3	8.5± 11	.11	184	-40.3	2.5± 7	.04
138	-51.8	1.5± 7	.03	185	-51.3	5.5± 7	.10
139	-65.0	3 ± 7	.06	186	-60.1	0 ± 7	0
140	-79.8	6 ± 7	.18	187	-69.0	0 ± 7	0

SA	b _{II}	DGL+EBL $\pm\sigma$	$\frac{\text{DGL+EBL}}{I_{\text{LOS}}^*}$
188	-57.3	15.5 \pm 7	.32
189	-48.3	10.5 \pm 7	.21
191	-19.5	47 \pm 15	.48
192	- 6.8	70 \pm 27	.24
194	2.1	0 \pm 55	0
195	- 1.7	68 \pm 54	.29
196	-12.0	28 \pm 20	.12
197	-25.4	6 \pm 17	.05
198	-40.1	9 \pm 7	.10
199	-52.8	0 \pm 7	0
202	-20.5	13 \pm 11	.11
203	-13.1	47 \pm 26	.43
204	-17.2	0 \pm 52	0
205	-31.7	17 \pm 8	.24
206	-27.9	33 \pm 10	.54

THEORY

Comparison between the observed DGL and theoretical levels computed from a reasonable galactic radiative transfer model determines two grain parameters - the albedo and the asymmetry of the scattering phase function (g). Details of this procedure can be found in Toller (1981). The results are albedo = $.61 \pm .07$, $g = .6 \pm .2$. The values derived for the albedo and g apply to particles in the general (intercloud) interstellar medium. Parameters for grains in dense clouds, the interplanetary medium, or circumstellar shells could differ if the chemical composition, size distribution, or shape of the grains depend on their environment. This work will be extended to 6400Å to provide further indications of dust composition.

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